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A study of hypertension screening by optometry

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STATEMENT OF PROBLEM

At least twenty-three million people in the United States today have some form of hypertension, with a criteria of greater than 90 mm diastolic pressure on at least two different days. In almost fifty percent of the cases where this is so these individuals are unaware of their having this disease. Along with this being responsible for the sixty thousand deaths attributed each year to high blood pressure and hypertensive heart disease, it is a major underlying factor in the annual total of more than one million deaths from cardiovascular disease and strokes. Our nation spends over seven billion dollars directly or indirectly yearly. (1)

Since optometry will in the near future be the entrance to an HMO program, we feel that it is of the utmost importance that screening hypertension be performed. The ocular manifestations are the four stages of hypertensive retinopathy. Stage I: Minimal narrowing or sclerosis of arterioles; Stage II: Copper-wire vessel reflection, A-V nicking, hemorrhages; Stage III: Silver-wire vessel reflection, "cotton-wool" patches, retinal edema; Stage IV: Same as stage III plus papilledema. (Keith,2 and Wagener,3) Also there are the visual field losses, central and peripheral scotomas and enlarged blindspots that accompany hypertensive retinopathy. (4)

In the early stages of hypertension a patient typically doesn't consult a physician since he is not in pain and has no incapacitation of his bodily functions. (5)

Patient's over the age of forty years have a higher probability than patients under forty years of age to visit an Optometrist's office as a result of receded near vision and also increasing probability of ocular pathology, i.e. cataracts, that are associated with aging.

Because of this, the Optometrist may be the first on the health care team to examine this individual. This screening service will allow the patient the benefit of speedy treatment of an insidious and progressive disease earlier in its course while, with treatment, prognosis is still good. The Dental Screening Study in Bergen County, N.J., demonstrates that such a program is possible and necessary. (6, see later)

Optometrists are qualified as a result of their training in the professional studies to measure arterial pressure as part of a routine within a standard visual examination. Further, since there is very little patient anxiety during a visit to an optometrist, as say, compared to visiting a dentist, the measured arterial pressure would be less subject to error from psychic factors.

EXPERIMENTAL DESIGN

Three instruments were employed in our screening for hypertension. These were the stethoscope, sphymomanometer and opthalmoscope. The former were used to take blood pressure readings and the latter was used to view any fundus changes as a result of hypertension. Through personal communication with a local physician (Dr. Robert Williams) the above instruments were identified as constituting a reliable procedure for screening for hypertension.

For the purpose of this study one hundred individuals twenty five years of age and older were screened. We used this age population based on findings from previous similiar screening projects, in paricular, the Bergen County (N.J.) Study on Hypertension Screening by Dentists. (7)

For each subject we took their systolic and diastolic pressures with the sphymomanometer and stethoscope. Then their fundus was observed with the ophthalmoscope.

The criterion we used for referral with suspected hypertension was an elevated diastolic pressure(over 90 mm Hg), with due consideration given to the accompanying systolic pressure.and a pulse rate that was over 100. Fundus changes showing typical reflex changes, and pathology associated with the four stages of hypertension were used in referring of patients.

Those individuals who meet our criteria for referral were sent to a local physician participating in the Pacific University Clinic's referral system. This is coordiated through the office of Dr. Earle Hunter, Clinic Director. A stamped self addressed envelope with a form for the participating physician to complete and return to us was provided. These returned forms were used to evaluate the criteria for referral by calculating the percentage of referred cases which are medically confirmed as hypertensive. Such an analysis enabled us to reach conclusions relative to the validity of our referral criteria, or to suggest better criteria.

The following procedure was used on the one hundred patients to screen for hypertension. The patient was seated and the arm cuff was always placed on the right arm. The arm cuff was inflated and the Korotkow sounds associated with systolic and diastolic pressures were listened for to make this indirect measurement of arterial pressure. The average of three trials was then found. The pulse pressure was also taken from the other readings. The following discussion of the signifigance of the Korotkow sounds is summarized from Burton. (8)

If a stethoscope bell is placed over the peripheral artery (i.e., brachial near the elbow), nothing can be heard at all in normal circumstances (unless the artery is severely constricted by too much pressure of application). When, however, a wide cuff containing an inflatable bag is inflated to pressures is allowed to fall slowly, characteristic sounds are heard from the brachial artery (the Korotkow sounds)

The pressure in the bag on the arm is transmitted to the tissues of the arm lying within the cuff (the cuff must be at least as wide as the diameter of the arm for the pressure to be effectively transmitted- that is, so that the artery pressure cannot escape being submitted to the pressure equal to that in the bag). When this is above the systolic pressure, the transmural pressure of the brachial artery is zero to negative. Consequently, even at the height of systole, the artery remains closed and no blood flows through. When, however, the bag pressure falls just below the systolic pressure, there is a brief interval (beginning of systole) in each cardiac cycle when the compressed segment of the artery can open against the tissue pressure, presenting a long narrow channel through which a "jet" of blood flows. In the remainder of the cardiac cycle, the tissue presure holds the artery closed. The velocity of the jet of blood is considerably increased above any velocity that was present when artery was not compressed, and the criterion for turbulence is exceeded. As a result, the jet of blood reaching the uncompressed artery below the cuff generates a sound (the first Korotkow sound). It is of short duration and sharp and is best described as a tapping sound. The pressure in the bag at the point where the first tapping sound is heard is taken as the systolic pressure. There may be strong reservations as to the correctness of this systolic criterion in cases of arteriosclerosis, since the rigidity of the artery may prevent its closure by the tissue pressure unless this exceeds the arterial pressure by a considerable amount; but at any rate, the high (indirectly measured) systolic pressure in these cases serve as a clinical index of their arteriosclerosis, even if the absolute value is not correct.

As the bag pressure falls lower, the proportion of the cardiac cycle in which the artery is patent increases, and it is wider when open; yet the conditions for turbulence and instability of the stream when emerging from under the cuff are still satisfied. The sound becomes louder and extended in time; then reaches a maximum intensity and begins to diminish, eventually to "disappear" (the velocity has fallen too close to the critical value). While there has been general acceptance of the best criterion for the systolic pressure (the first tapping sound), there has been much controversey as to the criterion for diastoliic pressure.

At a pressure just below that where the sound begins to diminish, there is a change in the character of the sound known as "muffling". The sound loses its ringing, staccato quality altogether and becomes a thumping, rather than tapping. The muffling occurs at a bag pressure very close to the diastolic pressure (as verified with catheters by direct measurement) and is undoubtedly the best criterion, both theoretically and in practice, for diastolic pressure. It tends to be a few millimeters above the true dialstolic pressure.

Why is there an association of change in character of sound and the true diastolic pressure? As long as the bag pressure, there will be in the cardiac cycle, a period that may be brief, in which the artery is closed. The successive periods of sound are therefore interrupted by brief intervals of silence. When the bag pressure falls below diastolic pressure, the artery is never closed and the sound is not interupted by silent periods. This can explain the change in character from staccato to muffled.

There is a sound reason based on theory for the muffling as the best diastolic criterion. In practice, it proves to be more reliable than the alternative, the disappearance of sound, in comparisons where direct measurements of pressure are made.

On the average, in a normal subject at rest, the disappearance of the sound occurs in a bag pressure about 8 mm Hg below true diastolic pressure. The disappearance of the sound indicates that the velocity of the blood stream has fallen below whatever the critical value may be. There is no reason why, except by chance in normal subjects, this should correlate with the diastolic pressure. Indeed, if a normal subject is compared at rest and immediately after heavy exercise, this becomes apparent. At rest, the blood pressure may be systolic, 120 mm; diastolic by muffling, 80 mm; diastolic by disappearance, 75 mm. After exercise, these values may be systolic, 170 mm; diastolic by muffling, 85 mm; diastloic by disappearance 40 mm. The reason for the low diastolic by disappearance is increased flow through the arm after exercise means a much greater velocity, enough to be above the critical value, even when the compression by the bag is very slight. In this case, no one could claim any correspondence between this disappearance criterion and the true diastolic pressure.

For the above reasons all three criteria were used on each patient, such as the following example- 120/80/75.

RESULTS

During our study, blood pressure readings were taken for 100 patients choosen randomly from the Pacific University College of Optometry clinic. Twenty-three of these patients had elevated readings according to our standards previously mentioned and/or those standards used by their family physicians. Of the persons with "elevated arterial pressure," 16 had knowledge of this condition and were under physician's care, the remaining 7 were unaware of any abnormality in their arterial pressure.

Our study employed 56 males and 44 females, ranging in age from 25 to 82 years of age. It is very evident that there was an increase in arterial pressure with an increase in age regardless to the patient's sex. Judged by subjective evaluation, there seemed to be a high correlation between obesity and high arterial pressure. A sharp peak occurred at 49 - 57 (fig. II) years of age for men with high readings and for women 58 -69.(fig. III) Thus for these age groups especially, screening by optometrists would be beneficial. Elevated pressure was found in 19% of the men screened and 22% of the women screened, regardless of age.

From the results of this study we estimate that approximately 20% of all patients over the age of 25 years will have elevated arterial pressure. (fig. I) Of this group 27% will be unaware of this condition existing.(fig. IV)

As a second part of the study, we began a comparison of the Sphygmostat with the conventional stethoscope and sphymomanometer method for taking arterial pressure. Because of mechanical problems with the Sphygmostat this part of our study had to be terminated after only a few trials. Based on this limited experience however, we found that readings with the Sphygmostat did not correlate with the standard method, and cannot recommend the Sphygmostat for rountine use by optometrists. Further, we see no reason why optometrists, trained during the last ten years, should not be able to use the introductory training provided by their professional programs in measuring arterial pressure in man, and with a small amount of practice, become proficient in the standard technique.

DISCUSSIONS AND CONCLUSIONS

We feel that this study shows conclusively that arterial hypertension screening should become a routine part of a standard optometric examination. Our study agreed closely with a similiar study that was performed by dentists, in which 5 out of every 100 patients had undetected hypertension. Our study showed 5 out of every 100 patients had undetected hypertension. (This study was performed in Bergen county, N.J. and entailed the screening of 1343 patients.) (9)

We found the patient response was very favorable, so much so that husbands and wives often requested us to take their mates arterial pressure. Many patients were surprised to find that optometrists could perform this service. It seemed quite apparent to us that many favorably revised their outlook on Optometry.

From many recently published articles it is apparent that there is a definite relationship between high arterial pressure and increased intraocular pressure. See Drucker for a recent review of this correlation. (10)

One of the resolutionsmade this past March for the AOA House of Delegates consideration was to " encourage optometrists to routinely take blood pressure readings as a screening device for hypertension and a diagnostic aid in spotting glaucoma." (11)

Hopefully from this study the need for and practicality of hypertension screening by optometrists has been shown. The proficiency in the use of the stethoscope and sphymomanometer requires some experience, but the skill is readily acquired and, once learned, can be used as easily and quickly as any presently available tonometer. For an individual breakdown of the patients in this study see Table I and for a sample of our referral form see the page 12.

We both plan to use this techigue in our practice and we feel that the undertaking of this thesis project was very beneficial.

From: Pacific University
College of Optometry

Re: Name____________________ Age-
Address________________
____

Date: ____________________

Dear Dr.____________________,

This patient has undergone a routine Pacific University Visual Examination, and has been included in a hypertension screening project. The routine optometric examination was supplemented by measurement of arterial pressure. We would appreciate it if you would examine this patient for possible hypertension, which is suspect according to our findings.

Ophthalmoscopy Findings

( ) narrowing of arteries
( ) copper wire reflex
( ) silver wire reflex
( ) A-V nicking
( ) Other________________
____

( )flameshaped hemorrages
( )small exudates
( )cotton wool patches
( )vascular occlusion

Baumanometer Readings (seated)

	Systolic	Diastolic
#1	________	________
#2	________	________
#3	________	________

Date____________________
Time____________________
Mean Pulse-

Upon examining____________________, I find that arterial hypertension (is) (is not) present. Treatment (will) (will not) be initiated. My baumanometer findings indicate the arterial pressure to be ____________.

____
Physician

We would appreciate your sending us your findings on this patient, to supplement our study on hypertension as soon as possible. Thank you.

Michael Spiegel
Douglas Weberling

TABLE I

Individual Results of 100 Patients

Init.	M/F	Age	Korotkow Sounds 1st/4th/5th	Mean Pulse	Under Treatment	Referral
G.K.	F	46	133/87/82	103		
J.M.	F	35	123/81/74	95		
V.T.	F	59	140/80/75	95	*	
V.T.	M	62	123/78/73	91		
J.C.	F	47	143/81/75	94		
D.P.	M	29	128/80/75	100		
H.C.	M	45	119/85/80	104		
R.H.	M	37	117/81/74	100		
B.B.	M	34	119/83/76	102		
M.K.	F	54	122/87/83	104		
M.F.	F	58	147/91/87	110		*
W.P.	F	73	132/77/73	97		
R.B.	M	47	119/84/78	103		
L.C.	F	36	116/84/78	100		
N.R.	M	25	109/73/66	98		
J.S.	M	28	107/69/63	89		
M.W.	F	45	107/78/73	98		
M.H.	M	25	118/80/76	99		
T.G.	F	45	131/87/84	103	*	
H.H.	M	39	118/83/76	103		
W.B.	M	44	130/86/80	106	*	
L.S.	F	37	112/71/67	91		
M.S.	M	49	121/84/77	96		
H.G.	F	62	125/81/74	100		
L.B.	F	38	110/80/72	97		
J.W.	F	49	111/88/80	104	*	
R.S.	F	43	134/93/87	110		*
F.G.	M	65	160/100/95	135	*	
R.H.	M	38	120/82/76	99		
E.H.	F	35	120/76/70	84		
D.S.	M	32	118/71/64	91		
D.W.	M	29	130/74/66	92		
L.O.	F	29	118/78/73	91		
M.H.	M	71	155/95/89	115	*	
H.H.	M	82	142/75/70	93	*	

Int.	M/F	Age	Korotkow Sounds 1st/4th/5th	Mean Pulse	Under Treatment	Referral
R.S.	M	28	110/75/70	95		
A.M.	F	71	125/77/71	93		
J.M.	M	24	120/81/77	103		
J.D.	M	67	112/75/70	93	*	
J.S.	F	30	118/81/77	103		
A.D.	F	64	151/91/87	109	*	
A.L.	F	39	125/80/74	97		
D.V.	F	40	120/82/78	104		
D.G.	M	26	111/70/66	92		
P.C.	M	27	11/80/76	100		
B.F.	M	29	116/80/76	102		
S.R.	M	26	115/73/69	91		
N.G.	F	34	126/82/75	104		
B.P.	M	27	119/80/74	100		
L.F.	M	29	128/78/72	96		
D.M.	M	52	127/79/74	99		
G.G.	M	36	130/81/76	101		
F.M.	M	53	150/101/98	140		*
H.D.	M	28	110/81/77	103		
C.B.	F	31	120/30/76	102		
S.D.	F	36	110/77/72	95		
J.F.	F	32	110/70/63	92		
M.B.	F	44	120/80/76	110		
D.W.	M	50	130/90/87	114	*	
A.C.	F	62	130/80/76	100	*	
R.M.	M	41	150/106/100	136		*
E.W.	F	82	127/75/71	105	*	
D.J.	M	40	123/73/67	95		
W.M.	F	34	150/100/97	126		*
K.W.	M	57	132/94/87	124		*
B.M.	F	42	120/85/82	107		
G.S.	M	58	146/90/85	126	*	
C.S.	F	77	121/85/81	109	*	
M.H.	F	58	155/98/92	128	*	
D.E.	F	41	110/80/76	102		
P.S.	M	50	118/86/82	108		

Int.	M/F	Age	Korotkow Sounds 1st/4th/5th	Mean Pulse	Under Treatment	Referral
J.E.	M	41	120/84/80	110		
D.H.	M	30	126/86/81	106		
C.R.	M	25	123/76/72	98		
D.S.	M	26	115/78/73	102		
U.C.	M	46	134/86/80	104		
M.H.	F	42	108/77/71	103		
C.H.	F	25	121/80/76	110		
A.H.	M	48	111/87/82	117		
M.C.	F	43	121/78/72	100		
D.A.	M	34	124/78/73	102		
R.M.	F	60	133/87/81	107		
B.B.	M	58	133/79/73	102		
I.N.	F	69	157/87/82	115		
A.D.	F	58	140/84/79	109		
L.C.	M	62	140/89/83	113		
I.M.	F	53	120/79/75	104		
C.M.	F	44	140/85/81	109		
M.G.	F	38	151/101/96	133		*
E.K.	M	61	131/69/63	93		
W.B.	M	54	130/88/82	120	*	
D.M.	M	57	129/73/67	97		
M.S.	M	26	127/77/70	103		
L.W.	M	33	117/76/70	100		
B.B.	M	47	139/85/80	109		
J.S.	M	44	119/83/79	107		
C.P.	M	34	120/76/76	106		
L.L.	M	45	151/96/90	132		
TOTAL						
100	56-M 44-F				16	7

Key: Int. = Patients initials
M = Males
F = Females
Korotkow Sounds:
1st = systolic pressure
4th = diastolic pressure - muffling sound
5th = diastolic pressure - no sound

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FIGURE I

Distribution of Arterial Pressure by Age in a Sample of 100 Individuals

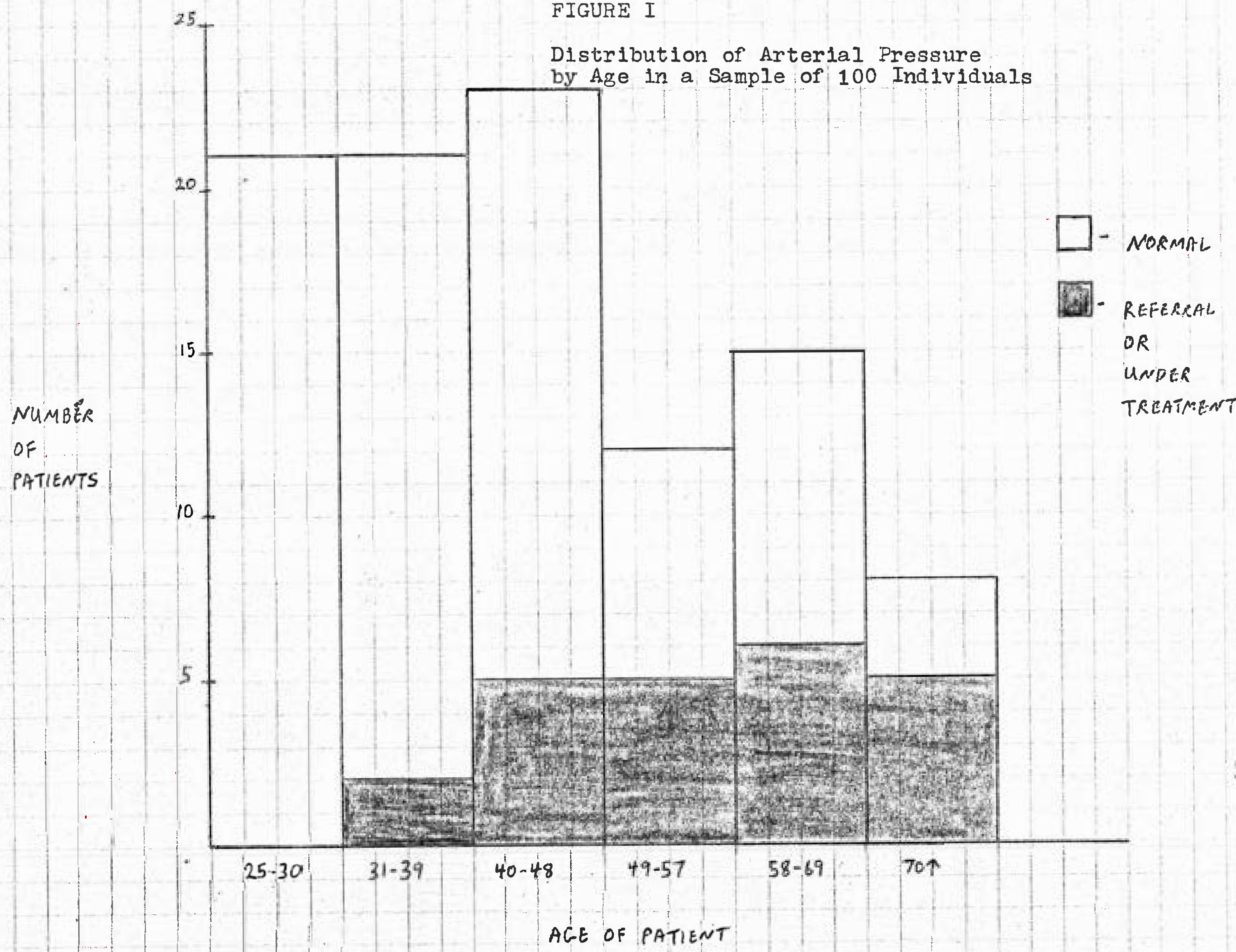

FIGURE II

Distribution of Arterial Pressure by Age in a Sample of 56 Males

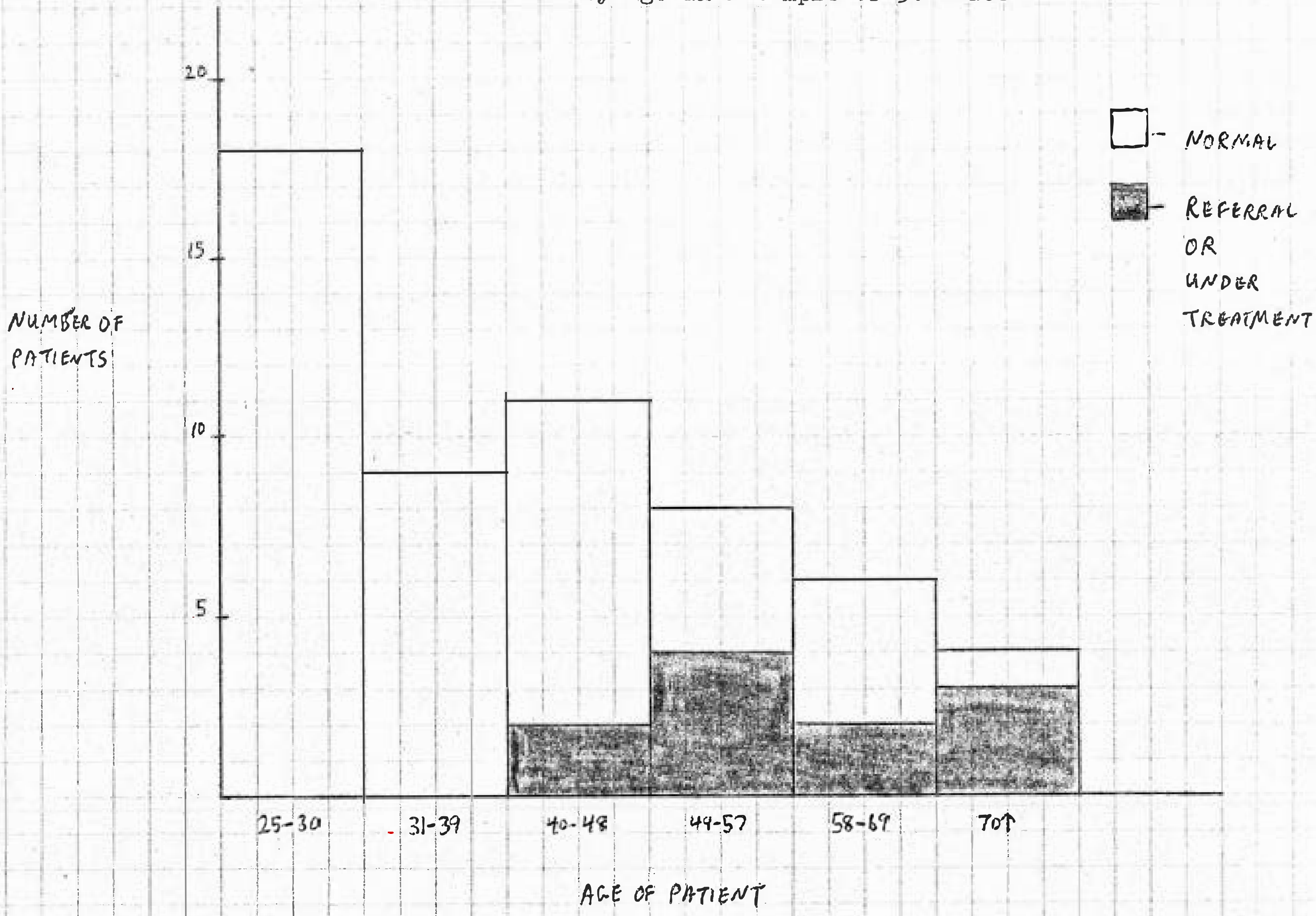

FIGURE III

Distribution of Arterial Pressure by Age in a Sample of 44 Females

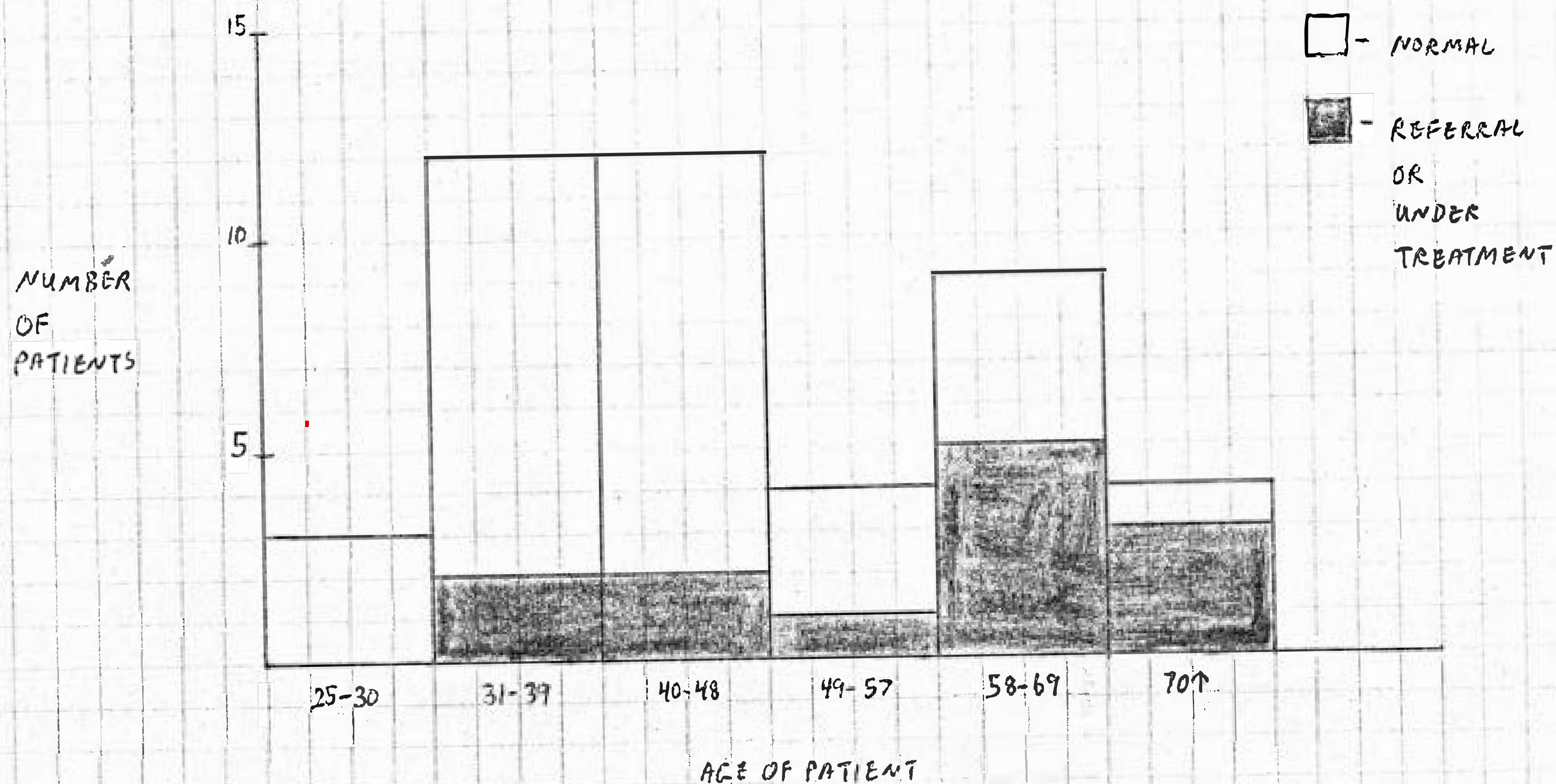

FIGURE IV

Distribution of Hypertensive Patients by Age

Previously Diagnosed versus Previously Undiagnosed